FarmFacts

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General Description of Micronutrients

Micronutrients are essential plant nutrients that are required by plants in very small amounts. They include copper (Cu), manganese (Mn), boron (B), zinc (Zn), iron (Fe) and molybdenum (Mo). The amounts of individual micronutrients removed by Saskatchewan crops are less than 1 kg per hectare (1 lb/ac). The very small quantities required do not mean that they are less important in plant nutrition. Micronutrients are as essential to plant growth as nitrogen and potassium which are required in very large quantities. Micronutrients play a variety of different roles in plant nutrition. However, many of them work with enzymes to help facilitate a number of important biochemical reactions in the plant. A deficiency of any one of the micronutrients can restrict plant growth as surely and as severely as a deficiency of nitrogen.

The high cost and risk of yield loss from inappropriate application of micronutrient fertilizers necessitates extreme care in identifying micronutrient deficiencies and selecting products and methods of application. Soil testing for micronutrients is less reliable than for other nutrients, making recommendations difficult. The findings from recent research in Saskatchewan have been used to adjust recommendations at the Saskatchewan Soil Testing Laboratory.

Figure 1. Copper deficiency in wheat grown on a sandy gray soil near Nipawin. Deficiency symptoms, alone, are often insufficient evidence for diagnosing micronutrient deficiencies.

Possibilities of Deficiencies in Saskatchewan

Most Saskatchewan soils contain adequate amounts of micronutrients. Isolated instances of micronutrient deficiencies occur from time to time. However, the number of such deficiencies is insignificant in comparison to deficiencies in nitrogen, phosphate, potassium and sulphur. Claims of micronutrient deficiencies are often related to other problems which have been overlooked.

According to research conducted in the Prairie Provinces the micronutrient deficiencies possible in dryland crop production in Saskatchewan are as follows:

Copper

Copper deficiencies have been recorded for wheat production on organic (peat) soils and very sandy Gray soils. On these soil types, significant yield increases have been obtained with copper fertilization in field experiments.

Manganese

Manganese deficiencies have been recorded in field experiments on organic (peat) soils only. These deficiencies have been observed primarily in oats but could also occur with other crops such as

barley. Responses to manganese fertilizer have been obtained on peat soils across the northern fringe area of agricultural Saskatchewan from Nipawin in the northeast to Meadow Lake in the northwest. Peat soils with a high pH may be more likely to respond to manganese fertilization.

Boron

A few canola fields grown on sandy gray soils in Northern Saskatchewan have responded to boron application. Boron deficiencies for alfalfa may also be possible on sandy Gray soils.

Zinc

Very few responses to zinc fertilization have been obtained in Saskatchewan. Some responses to zinc fertilization have been reported on a few Northern or badly eroded soils and on soils where very large amounts of phosphorus fertilizer were applied.

Iron

Iron deficiency is virtually unknown in field crops in Saskatchewan at this time. Iron deficiency is not uncommon, however, for various fruit trees, shrubs and ornamentals such as roses, especially where soils have a high pH.

Molybdenum

Molybdenum deficiency for any crop has not been found in Saskatchewan.

Diagnosing Micronutrient Deficiencies

Diagnosing micronutrient deficiencies is not a simple one-step process and often involves a number of different pieces of information. A grower should consider proceeding with micronutrient diagnosis only when it is known that moisture, disease problems, salinity and other nutrient deficiencies such as N, P, K or S are not limiting the growth of crops. Then, the following steps are recommended:

1. Consider the Crop and Soil Type

Micronutrient deficiencies tend to be quite specific not only for soil types but for crop types and can be more likely in certain varieties within a given crop species.

Table 1 shows the crops and soils most likely to be deficient under dryland conditions in Saskatchewan.

2. Look for Plant Deficiency Symptoms

Visual symptoms of micronutrient deficiencies are often similar to each other and can resemble symptoms of other physiological stresses. However, plant deficiency symptoms can be useful as a first indication of which nutrient might be deficient.

Copper deficiency in wheat results in a burning or scorching of the upper leaves that eventually leads to curling and kinking of the leaf tips (see Figure 1). At a more mature stage, copper deficiency in wheat can result in weak stems and bending of the heads. Copper deficiency also causes poor grain filling, resulting in a high ratio of straw to grain.

Manganese deficiency in cereals results in light colored areas between veins in the upper leaves which can sometimes result in gray spots or gray specks (Figure 2). Manganese deficiency in oats has been described as "gray speck disease". The term "disease" is not correct because the problem is nutritional rather than pathologic in nature.

Zinc deficiency can cause light yellow blotches between veins on the older leaves of field beans. These older leaves will be pale green, short and narrow, while the younger leaves will have a normal healthy green color but will be small. Delayed ripening is also a symptom in field beans. Zinc deficiency in flax can result in grayish brown spots on the younger leaves. Shortened distances between nodes create a stunted or rosetted appearance.

Iron deficiency results in yellowing between the veins of young leaves.

Boron deficiency results in stunted or retarded growth of young plants and poor seed development. These symptoms could be confused with those of sulphur deficiency.

Do not apply micronutrients based on a diagnosis from nutrient deficiency symptoms alone. It must be emphasized that plant deficiency symptoms are only a first indication of possible micronutrient deficiencies. These symptoms can easily be confused or mistaken for one another, for environmental problems such as drought stress, or for disease problems.

3. Test soil and Plant Tissue

The DTPA soil test for copper provides a useful first approximation upon which to build a copper fertilizer program. All other micronutrient soil tests are less well documented for Saskatchewan soils and cropping conditions at this time. In general, micronutrient concentrations in soil are extremely variable within a field, making it very difficult to obtain conclusive information from any soil test.

Table 1 Crops and soils most likely to be affected by specific micronutrient deficiencies

Micronutrient	Most susceptible crop(s)	Most susceptible soil(s)
Copper	Wheat, alfalfa, oats	Organic (peat), sandy Gray
Manganese	Oats, wheat	Organic (peat)
Zinc	Field beans, flax, corn	High pH, High-lime, disturbed (levelled), cool and wet
Boron	Canola, alfalfa	Sandy, Gray
Iron	Ornamental shrubs and fruit trees	High pH, High-lime, poorly drained

Plant tissue tests can be particularly useful in assisting with micronutrient deficiency diagnosis. It is important to plant tissue testing to determine the concentration of a wide range of nutrients so that the concentration of one nutrient relative to another can be determined. It is quite probable that tissue testing will become the most definitive diagnostic technique for detecting micronutrient deficiencies in the future. For more information about plant tissue testing, contact the Saskatchewan Soil Testing Lab at the University of Saskatchewan in Saskatoon.

Due to the variability within a field, samples of soil or plant tissue should be taken from the specific area of suspected deficiency.

4. Apply Micronutrients to Test Strips

A profitable yield response to micronutrient fertilization is difficult to predict. Therefore, the micronutrient in question should be applied initially to a small test strip in a field. The yield from the strip should be compared to that from the adjacent area where all other nutrients have been applied as required.

Micronutrient Fertilizers and Application

At this time, the micronutrients most likely to be deficient in field crops are copper, manganese, boron, and, possibly, zinc.

Selection of micronutrient fertilizers is governed by the cost of the fertilizer, its effectiveness and its residual value. Chelates are normally effective in the first year of application but have little or no residual value due to the low rates of nutrient being applied. They are also more expensive than sulphate forms. Inorganic forms of micronutrient fertilizers may remain available in the soil for several years after application if applied at the recommended rates.

Copper can be mixed with the soil or applied as a foliar spray. For application onto mineral soils, broadcast 5 kg/ha (5 lb/ac) of copper in a finely divided form of inorganic copper, such as copper sulphate. For organic soils, apply 10 kg/ha (9 lb/ac). The copper should then be thoroughly mixed into the surface 15 cm (6 in) of soil before planting. The amount of copper sulphate which dissolves in fertilizer solutions is too small to make application with these fertilizers practical. However, copper sulphate may be applied in fertilizer suspensions. Considerable copper remains available in the soil for subsequent crops, so one soil application may be sufficient for several years. For foliar application, apply 0.5 kg/ha (0.5 lb/ac) of copper in the form of copper chelate. Copper chelate is water soluble and can be sprayed with normal spraying equipment. Applying copper onto organic soils which have marginal supplies of manganese may induce a manganese deficiency in cereals.

Manganese should be applied, for cereals, as a seedplaced band of 5-10 kg/ha (5-9 lb/ac) of manganese as manganese sulphate or similar compound. Lower rates of manganese can be applied as a chelate in a foliar spray. Broadcast applications of manganese are very ineffective.

Boron should be broadcast and incorporated into the soil. For field crops, apply 1.6 kg/ha (1.5 lb/ac). Boron toxicity

Figure 2. Manganese deficiency symptoms in oats grown on organic (peat) soil in the Meadow Lake area.

Table 2 Composition of several micronutrient fertilizers available in Saskatchewan

Fertilizer	Concentration of Nutrient in Product
Copper Fertilizers	
Copper sulphate	25% Cu
Copper chelate	percentage varies
Manganese fertilizers	
Manganese sulphate	26% Mn
Manganese chelate	percentage varies
Boron fertilizers	
Sodium borates	10-20% B
Zinc fertilizers	
Zinc sulphate	18-23% Zn

can be a problem if excessive rates are applied. Care must be taken to apply the correct amount and to apply it uniformly.

Zinc should be broadcast and incorporated into the soil. Apply 5-10 kg/ha (5-9 lb/ac) of zinc as finely divided zinc sulphate.

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